Advance

Low Frequency Signal Generators J1B & J2B

Instruction Manual

ADVANCE ELECTRONICS LIMITED

INSTRUMENT DIVISION

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Publication 1268 AWP 5/65/1500 Printed in England

Contents

			Page
SECTION	1	Introduction	5
SECTION	2	Specification	6
SECTION	3	Operation	8
	3.1	Power supply	8
	3.2	Frequency	8
	3.3	Output impedances	8
	3.4	Output level controls	9
SECTION	4	Circuit Description	11
	4.1	General	11
	4.2	Wien bridge oscillator	11
	4.3	Stabilisation circuit TH1 and TH2	12
	4.4	Driver amplifier V2	12
	4.5	Output circuit	13
	4.6	J2B meter circuit	13
	4.7	Power supply circuit	14
SECTION	5	Maintenance	15
	5.1	General	15
	5.2	Fuse replacement	15
	5.3	Valve replacement	15
	5.4	Introduction to recalibration	15
	5.5	Voltage calibration J1B	16
	5.6	Voltage calibration J2B	16
	5.7	Output impedance adjustment	17
	5.8	Frequency calibration	18
	5.9	Final adjustments	20

SECTION 6 Components List and Circuit Diagram 24

SECTION 7 Guarantee and Service Facilities 26

Illustrations

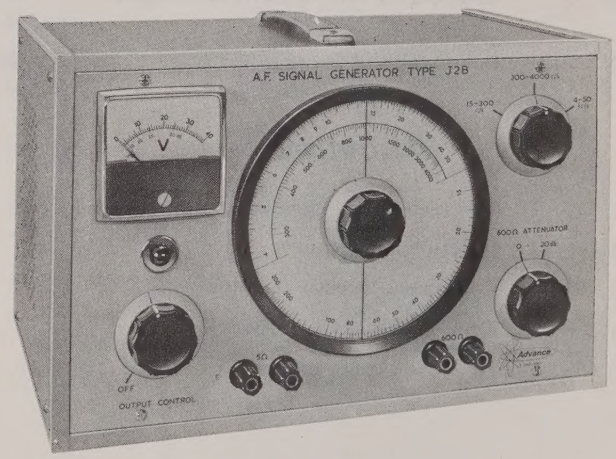
Fig. 1 Low frequency signal generators J1B and J2B

Fig. 2 Functional diagram

Fig. 3 Component layout - top view

Fig. 4 Component layout - underside view

Fig. 5 J1B & J2B circuit diagram



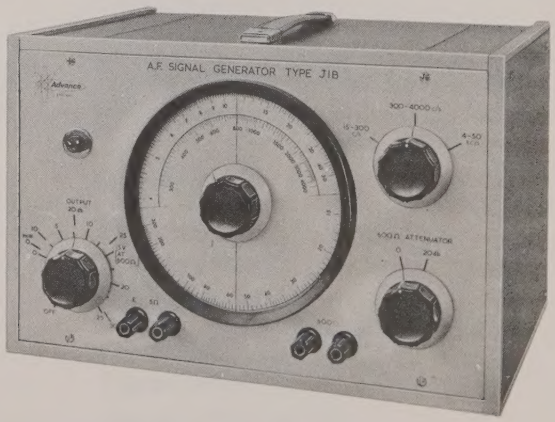


Fig. 1 Low frequency signal generators J1B and J2B

Introduction **Section 1**

The J1B and J2B Signal Generators, like their well-established forerunners the J1 and J2, are two similar instruments which provide sinusoidal outputs in the frequency range 15c/s to 50kc/s. Two separate output arrangements with continuous level control are provided on each instrument. One output is of 600Ω impedance and isolated from earth, having a maximum output level of 1W; the alternative output has an impedance of 5Ω connected to earth and with an output level of at least 500 milliwatts.

The J1B version of the instrument uses a calibrated output control to give an indication of output level, while the J2B output level is indicated on a front panel meter.

Each instrument contains a resistance-capacitance Wien bridge oscillator which is connected to the output stage via a buffer amplifier. The inherent stability of the oscillator and the use of feedback circuits contribute to an output which is substantially constant over the whole frequency range. Overall distortion at full output power is less than 2% (34dB down on fundamental).

The J1B and J2B operate from a.c. power supplies of 105 to 125V and 210 to 250V, 40 to 100c/s.

Frequency Ranges	A - 4kc/s to 50kc/s B - 300c/s to 4kc/s C - 15c/s to 300c/s Accuracy ± (2% + 1c/s).
Output	Output into 600Ω 0.1mW to 1W (0.25V to 25V), continuously variable. Accuracy: Model J1B ± 2dB Model J2B ± (1dB + 1.5% F.S.D.) Maximum output into 5Ω greater than 500mW, continuously variable.
Output Impedance	The output impedance approximates to 600Ω over the whole range. Where close accuracy is required the 20dB attenuator should be used.
Attenuator	A 20dB 600Ω attenuator is incorporated. This is a π pad built of close tolerance resistors. When switched in circuit it provides a very accurate output impedance with a maximum output of 10mW (2.5V).

Distortion	Total harmonic and hum content as compared with fundamental, above 100c/s: better than 34dB down (2%) at full output better than 40dB down (1%) at 100mW. There is a slight increase in distortion below 100c/s, but it is still low, down to 15c/s.
Power Supplies	J1B, J2B: 105 to 125V, 210 to 250V, a.c. only, 40 to 100c/s.
Consumption	Approximately 40W.
Dimensions	11 1/8in. wide, 7 5/8in. high, 9 5/8in. deep (28.3 x 19.4 x 24.4 cm).
Weight	20 lb (9.1kg).
Finish	Light blue case and side panels with otter grain finish, medium grey painted frame with light grey front panel.

3.1 POWER SUPPLY

The standard J1B and J2B are normally despatched with the supply transformer set to operate at 210 to 250V.

For operation at 105 to 125V the supply transformer tappings must be changed as follows:

(1) Remove the four instrument head screws from the left hand side of the instrument and carefully withdraw the side panel. The supply transformer is located on the left hand side of the chassis behind the OUTPUT CONTROL.

(2) Remove the connection between tag 2 and tag 3. Connect tag 1 to tag 2, and tag 3 to tag 4. Replace the left hand side panel.

The instrument is provided with a 3-core cable so that the case may be earthed to the supply earth if desired.

The on-off switch is incorporated in the output control.

3.2 FREQUENCY

A signal of any frequency between 15c/s and 50kc/s is set by using the range switch in conjunction with the calibrated dial.

Continuous adjustment is by means of the slow motion control situated centrally on the dial.

3.3 OUTPUT IMPEDANCES

Two alternative output impedances are available as follows:

(a) A 600Ω output from the right hand pair of red terminals, labelled

600Ω. The accuracy of the output impedance is greatly improved when the 20dB attenuator is in use. These terminals are not earthed, but an earth connection to either terminal can be made if desired.

(b) A 5Ω output from the black E terminal (an earthing terminal) and the adjacent red terminal. The earthing terminal can be used for general earth connections as required.

3.4 OUTPUT LEVEL CONTROLS

Variation of the output level is accomplished by means of a front panel potentiometer control and a 20dB attenuator which can be switched into circuit.

On the J1B, the output control is calibrated in volts and watts (into 600Ω). When the attenuator is switched in circuit, the voltage scale should be divided by 10. The voltage at high impedance with the 20dB attenuator in use is twice the voltage indicated, with no increase in distortion. When the J1B is used with a high impedance termination and the 20dB attenuator is not used, a voltage approximately twice that indicated is obtained with some increase in distortion at high levels.

On the J2B, the output without the 20dB attenuator is that indicated by the meter, there being no increase in distortion if the output is not terminated. When the 20dB attenuator is in circuit and the output is loaded with 600Ω, the output voltage is one-tenth of that indicated. When the load is of high impedance the output voltage is one-fifth of that indicated.

The output level at the 5Ω sockets of the J1B and J2B is controlled by the OUTPUT control alone, and a maximum output of 500mW is available from either instrument.

4.1 GENERAL

A functional diagram of signal generators J1B and J2B is shown in Fig. 2, the common circuit diagram for these instruments is shown in Fig. 5. Basically the circuit consists of a Wien bridge type oscillator switched in three ranges, followed by a triode driver stage and tetrode output stage working into the output transformers T1 and T2. Output transformer T2 is used only for the high frequency range A, and is selected by S1. The power supplies are derived from a full-wave rectifier using resistance/capacitance smoothing, and from a low voltage winding supplying the valve heaters.

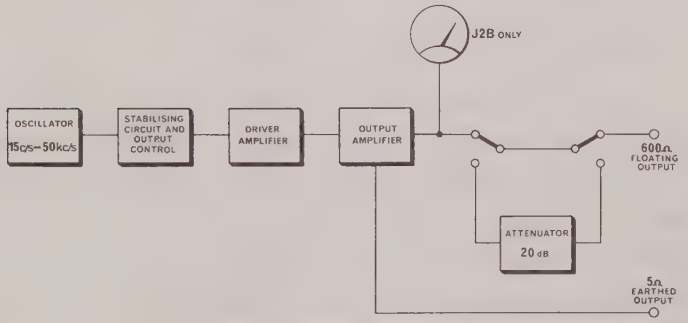


Fig. 2 Functional diagram

4.2 WIEN BRIDGE OSCILLATOR

The series RC elements of the bridge are formed by R4, R5 or R6 and part of the ganged capacitor designated C5, together with the trimmer capacitor C4. Parallel RC elements are formed by the other part of the ganged capacitor designated C6 and either R1, R2 or R3. Capacitors C1, C2 and C3 are trimmers across these resistors, required for calibration purposes. R15 is selected during manufacture

to provide, in conjunction with R7, a means of frequency calibration at the low frequency end of the range (15c/s).

The common junction of the bridge elements are connected to the V1a/V1b amplifier at the V1b grid. Other bridge connections are made via C8 to V1a anode and via C7 to the V1a cathode circuit. The two sections of V1 are RC coupled from V1b anode to V1a grid. The connection of R11 to the junction of R9 and R10 provides negative feedback to V1a, and automatic bias is produced by the cathode resistors R9 and R10. The oscillator is connected to the thermistor stabilising circuit from the bridge side of C8.

4.3 STABILISATION CIRCUIT TH1 AND TH2

The operation of the thermistors TH1 and TH2 are to some extent interdependent, but TH1 can be considered as the principal means of stabilising the output frequency and TH2 the output amplitude, with change in temperature. R14 is a means of setting the thermistor current and is the preset output level control. RV1 is the front panel OUTPUT control. C10, connected across part of RV1, provides some compensation at the high frequency end of the working range. Connection to the driver stage is made via R16.

4.4 DRIVER AMPLIFIER V2

V2 is a triode amplifier with a resistive anode load that is coupled to the output amplifier via C14. Part of the hum voltage existing across R21 in the HT line is applied as negative feedback at the V2 grid, thus reducing the hum level in the output signal. Normal negative feedback is connected from the output amplifier to the V2 cathode

circuit via R20 and C13. Coupling to the output stage is made via capacitor C14.

4.5 OUTPUT CIRCUIT

The output amplifier V3 is a tetrode amplifier with an anode load that is selected by S1c. For the 600Ω output on the high frequency range A, T2 is connected in circuit and the primary and secondaries of T1 are short circuited. For the middle and low frequency ranges B and C, the transformer T1 is connected in circuit and T2 primary and secondary windings are short circuited. For the 5Ω output, on the other hand, the low impedance output from T2 is used on the high frequency range and low impedance outputs from both T1 and T2 are used in series for the middle and low frequency ranges.

Some automatic negative bias is produced by R23 in the cathode circuit of V3 which is partially by-passed by C15, thus providing increased amplification at the top end of the range. Preset potentiometer R24 is used to set the standing d.c. current in V3 and hence the output impedance of the signal generator. The 20dB output attenuator is a conventional unbalanced π type, formed by resistors R25, R26 and R27 and is switched into circuit by S2.

4.6 J2B METER CIRCUIT

The meter circuit, consisting of the full-wave bridge rectifiers MR1-MR4 and meter M1, is only fitted to J2B instruments and is connected directly across the 600Ω input to the 20dB attenuator. When the 20dB attenuator is in use and the 600Ω output is properly terminated,

the meter reading must be divided by ten to obtain the true output level.

4.7 POWER SUPPLY CIRCUIT

The a.c. supply is connected to T3 via the fuse FS1 across either the whole of the primary winding in series, for 210 to 250V working, or across the two halves of the primary winding in parallel, for 105 to 125V working. Alteration from one voltage to the other can be made by altering soldered connections as indicated on the transformer tag panel and with reference to the circuit diagram. The indicator neon lamp N1 is connected across one half of the primary winding.

The T3 secondary winding is connected to the full wave rectifier valve V4. Capacitors C18 and C19 form a simple decoupling circuit to earth for HF frequencies that may be picked up internally or from adjacent equipment. The 6.3V winding supplies the heater chain and has a straightforward hum bucking network formed by R29 and R30 that decouples the hum frequencies to earth.

5.1 GENERAL

The J1B and J2B have excellent component accessibility and any maintenance task can easily be carried out after the simple removal of a side-panel or the wrap-round case. The general component layout of both instruments is illustrated in Figs. 3 and 4.

5.2 FUSE REPLACEMENT

Viewing the instrument from the rear, remove the right hand side-panel. Fuse FS1 will be immediately accessible to the rear of the supply transformer T3. The correct replacement fuse is a 500mA Belling Lee type L1055 or equivalent, Advance Part No. 352.

5.3 VALVE REPLACEMENT

All the valves are mounted on the upper half of the instrument chassis and are accessible when the case is withdrawn, after removing four instrument head screws at the rear. Instrument calibration will not normally be affected by valve replacement, but changing V1 will require a check of the current through TH1 as outlined in para. 5.5 (5).

5.4 INTRODUCTION TO RECALIBRATION

After a long period in service the instrument may need some small internal adjustments to regain maximum frequency or voltage calibration accuracy. The entire recalibration procedure is listed below but unnecessary tampering of preset controls is not recommended.

5.5 VOLTAGE CALIBRATION J1B

(1) Switch on the instrument and terminate the 600Ω output terminals via a switch in a 600Ω, 1% resistor having a minimum rating of 1.5W.

(2) Connect the 600Ω terminals to the 'Y' input of an oscilloscope and adjust the signal generator frequency to 1kc/s.

(3) Turn the OUTPUT control fully counter-clockwise until the display on the oscilloscope just becomes a straight line. This is the position of zero output and the index line on the OUTPUT knob should coincide with the zero point on the voltage scale. If necessary, remove the plastic top from the knob and adjust the relative position of the knob on the shaft until the index mark and zero mark coincide.

(4) Turn the OUTPUT control to 25 on the voltage scale and adjust the frequency to 50kc/s. Connect a valve voltmeter VM77B or similar instrument to the terminated 600Ω output terminals and adjust preset potentiometer R14 at the rear, until a reading of 26V is obtained.

(5) Connect the valve voltmeter VM77B across R34 and adjust the output frequency to 50kc/s. A minimum voltage of 13mV should be measured across R34. If the voltage is less than 13mV, replace V1. If the voltage is still less than 13mV, replace TH1.

5.6 VOLTAGE CALIBRATION J2B

(1) Switch on the instrument and terminate the 600Ω output terminals

via a switch in a 600Ω, 1% resistor having a minimum rating of 1.5W.

(2) Connect the 600Ω terminals to a valve voltmeter VM77B or similar instrument. With the frequency set for 1kc/s, turn the OUTPUT control to a maximum, fully clockwise.

(3) Unlock R33 by turning the central screw counter-clockwise. Adjust R33 by rotating the 6BA nut surrounding the locking screw, until a meter reading of 27V is obtained. Lock R33 in this position by rotating the central screw clockwise, while keeping the nut steady.

(4) Set the frequency to 50kc/s and readjust R14 until an output level of 27V is obtained with the OUTPUT control set to a maximum.

(5) Connect the valve voltmeter VM77B across R34 and adjust the output frequency to 50kc/s. A minimum voltage of 13mV should be measured across R34. If the voltage is less than 13mV, replace valve V1. If the voltage is still less than 13mV, replace TH1.

5.7 OUTPUT IMPEDANCE ADJUSTMENT

(1) Reduce the output level to an indicated 15V and switch out the 600Ω termination. Adjust the output level to give exactly full scale deflection (FSD).

(2) Switch in the 600Ω termination and adjust preset potentiometer R24 at the rear, until the output is exactly half FSD. Repeat this procedure until the output reading with the 600Ω load is

exactly half the reading with no load. The 600Ω output impedance will now be correct.

5.8 FREQUENCY CALIBRATION

(1) Adjust the 600Ω terminated output level to 6V and, with the aid of an oscilloscope, use Lissajous displays to check the generator frequency against a reference frequency having an accuracy of at least $\pm$ 0.2%.

(2) Set the frequency to 50kc/s and, after carefully removing any sealing wax, adjust the Phillips type trimmer C4 to obtain a stationary Lissajous display. Access to C4 is obtained after removing the screening can as described in para. 5.8 (3).

(3) To adjust the frequency towards the 4kc/s end of the range A, release the screening can that covers the ganged capacitors by removing three 4BA nuts on the underside of the chassis. Adjust the outer plates only of the ganged capacitors C5 and C6, to align the scale figures to the input frequency.

NOTE The calibration of range A affects the calibration of both B and C ranges, and must therefore be carried out with great care.

(4) Switch to range C and set the scale to 25c/s. Adjust the output to exactly 25c/s by using a 50Ω potentiometer substituted temporarily in place of R15.

(5) Switch to 50kc/s and make any necessary adjustments to C4. Repeat the adjustments at 25c/s and 50kc/s until both frequencies are correct, by reference to the scale. Measure the resistance

of the 50Ω potentiometer in circuit and replace with the nearest preferred value resistor, $\frac{1}{4}$W rating (R15). Solder the resistor between R7 and the earth tag at the rear of the range switch S1a.

(6) Switch to range C and adjust C1 for correct scale calibration at 300c/s. If adjustment at 300c/s is not possible, readjust C4 until adjustment to 300c/s can be made using C1. Before continuing further adjustments recalibrate range A at 50kc/s using C3. Check that calibration at 25c/s and 300c/s is not affected. Check calibration accuracy at 200c/s, 100c/s, 50c/s, 25c/s and 20c/s. If an error greater than 1% exists at 100c/s first recheck that the A range calibration is correct. Next check that R1 and R4 are within 1% of 13MΩ.

(7) Switch to range B and adjust C2 for correct scale calibration at 4kc/s. Check the scale accuracy at the main points throughout the range. If frequencies are low, a resistor of 750Ω to 2.2KΩ must be wired in series with R3 (70KΩ on range A), and range A will need recalibration. Further adjustment of R15 at 25c/s may be necessary. If frequencies are high, a resistor of 5.6KΩ to 22KΩ must be wired in series with R1 (1MΩ on B range) in order to spread out the range.

(8) When the calibration is complete replace the screening can but do not secure to the chassis.

(9) Readjust C4 through the appropriate hole in the screening can to correct the calibration at the high frequency end of all ranges. Adjustment to C1 and C2 may also be necessary. Permanently fix C4 with sealing wax and replace the screening can, securing it firmly to the chassis with three 4BA nuts.

(10) Check that calibration over the entire frequency range is within $\pm$ 1%.

(11) With the OUTPUT control set to a maximum check that the frequency does not vary at the high frequency end of all ranges by more than 0.5%.

5.9 FINAL ADJUSTMENTS

(1) Check output impedance at 1kc/s as in para. 5.7 and adjust R24 as necessary.

(2) Set OUTPUT control to a maximum and adjust output to exactly 27V using R14 at 4kc/s, B range or 50kc/s, A range. Make adjustments at the frequency which produces the lower output level.

(3) With the output at 27V, 50kc/s check the voltage across R34 using the valve voltmeter. The voltage should not be less than 13mV.

(4) Set output to 25V, 1kc/s and check distortion on a distortion meter. Distortion should not exceed 1.5%. On the J2B repeat this check at the +20dB mark on the meter, when the distortion should not exceed 0.7%. Excessive distortion figures in either case could be due to hum i.e. insufficient smoothing of HT or of ripple injection at V2 grid. Check components R17, C12, R21.

(5) Check the distortion on range A at 4kc/s, 25V. Distortion should be no greater than 2%.

(6) Connect a valve voltmeter to the 5Ω output terminals. Switch

in the 20dB attenuator. The output level should be between 2.2V and 2.6V.

(7) Replace the cover and side panels and recheck the frequency and output levels at both ends and mid-scale of each range.

(8) Recalibration is now complete.

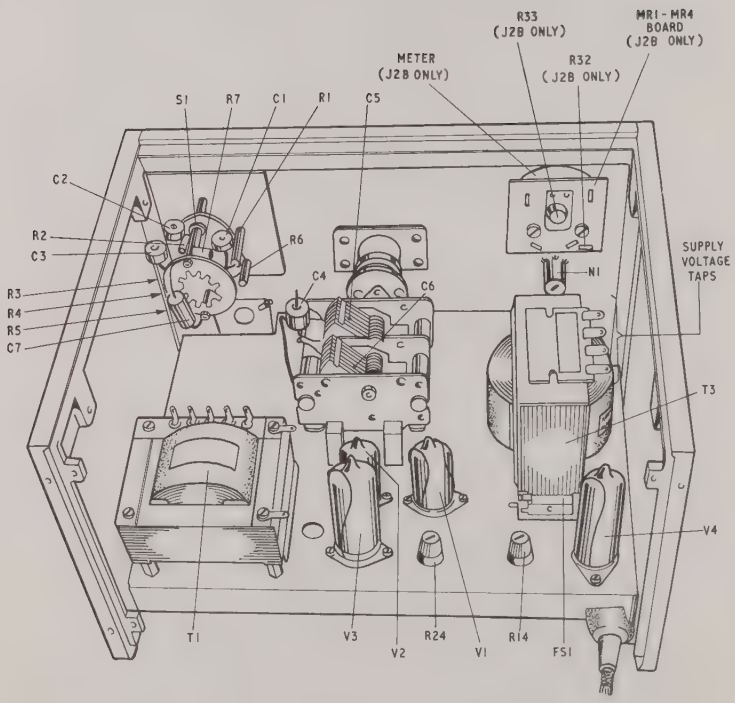


Fig. 3 Component layout - top view

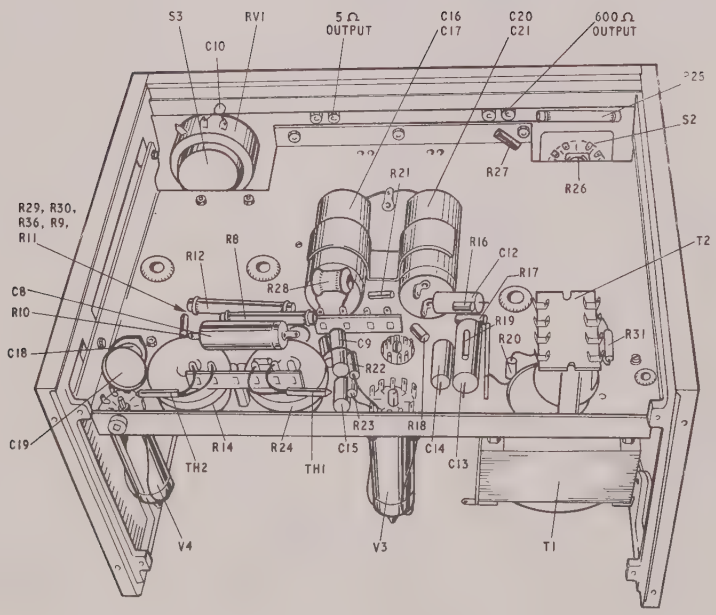


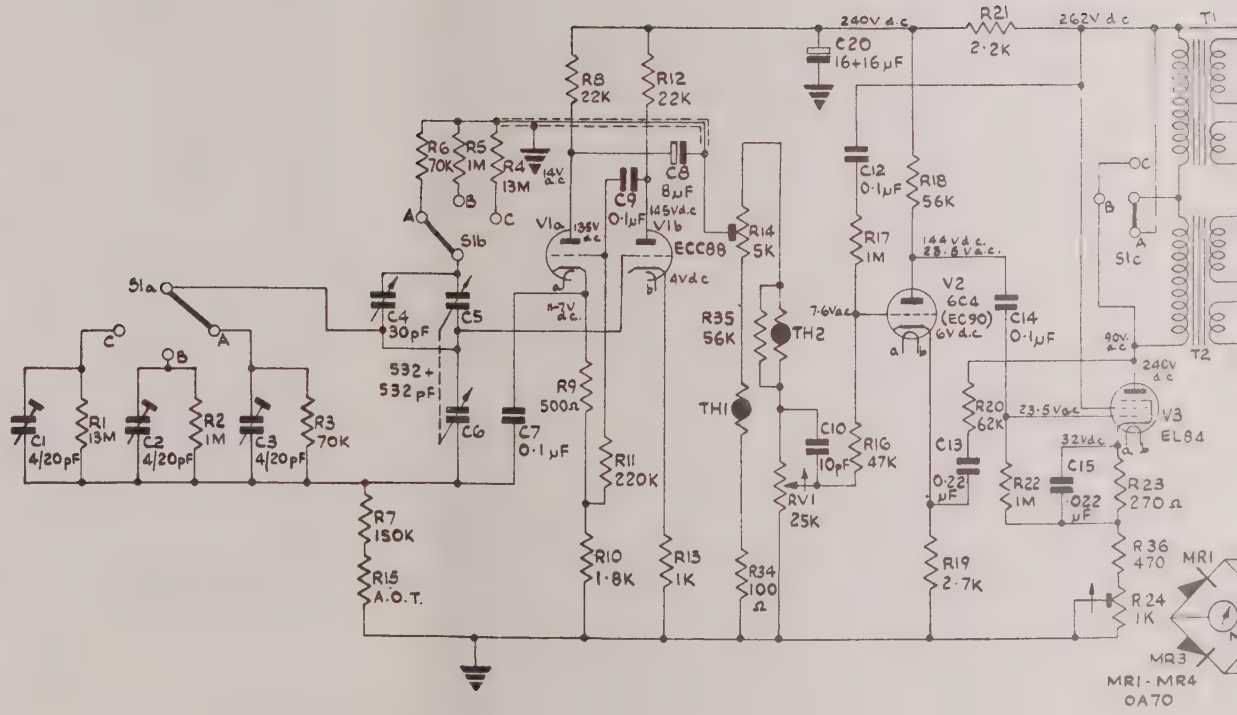
Fig. 4 Component layout - underside view

Components List and Circuit Diagrams Section 6

RESISTORS (RRC 5SWD18 unless specified)				
Ref	Description			Part No.
R1	13M	±1%	Welwyn C23	4377
R2	1M	±1%	Welwyn C22	6701
R3	70K	±1%	Welwyn C22	6702
R4	13M	±1%	Welwyn C23	4377
R5	1M	±1%	Welwyn C22	6701
R6	70K	±1%	Welwyn C22	6702
R7	150K	±5%	Welwyn C21	10253
R8	22K	±10%	Erie 8	6706
R9	500Ω	±10%	Erie 16	6704
R10	1.2K	±5%		2087
R11	220K	±5%		4023
R12	22K	±10%	Erie 8	6706
R13	1K	±5%		384
R14	5K		Preset Pot. Colvern CLR901	7700
R15	Adjusted during manufacture.			
R16	47K	±5%		318
R17	1M	±5%		766
R18	56K	±5%		756
R19	2.7K	±5%		311
R20	47K	±10%	Erie 16	2933
R21	2.2K	±5%	RRC 5SWD33	2351
R22	1M	±10%	Erie 16	1171
R23	270Ω	±10%	Erie 16	3418
R24	1K		Preset Pot. Colvern CLR901	7699
R25	750Ω	±5%	Erie 2	7780
R26	2.97K	±1%	Welwyn C22	3614
R27	733Ω	±1%	Welwyn C22	3615
R28	500Ω	±10%	W/W Dubilier A1	11248
R29	22Ω	±10%	Erie 8	6850
R30	22Ω	±10%	Erie 8	6850
R31	100Ω	±10%	Erie 16	3416
R32	33K	±5%	(J2B only)	317
R33	10K		Preset Pot. Egen 123 (J2B only)	1064
R34	100Ω	±10%	Erie 16	3416
R35	56K	±5%		756
R36	470K	±10%	RMA8	1530
RV1	25K		Linear Pot. Colvern CLR4983/12	7701

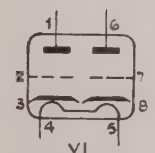
CAPACITORS (Wima Tropyfol M unless specified)				
Ref	Description			Part No.
C1, C2, C3	4/20pF		Trimmer Triko 004a/10BMD.20	4910
C4	30pF		Trimmer Mullard PN2821236	1620
C5, C6	532+532pF		2 gang Polar E24 Type C1602	11859
C7	0.1uF	400V		2385
C8	8uF	450V DC	electrolytic Hunts JE553T	10760
C9	0.1uF	400V		2385
C10	10pF	10%	Hunts Hi-Q N750	7703
C11			NOT USED	
C12	0.1uF	400V		2385
C13	0.47uF	400V		2365
C14	0.1uF	400V		2385
C15	.022uF	400V		4243
C16, C17	16+16uF	350V DC	electrolytic Hunts JE413	7014
C18, C19	0.005uF	250V AC	Erie ERL1304 ES613	4378
C20, C21	16+16uF	350V DC	electrolytic Hunts JE413	7014

VALVES		
Ref	**Description**	**Part No.**
V1	ECC88	4548
V2	6C4 (EC90)	4549
V3	EL84	12785
V4	EZ81	12070
MISCELLANEOUS		
Ref		
PS1	Fuse 500mA B/Lee L1055	352
MR1 MR2 MR3 MR4	Rectifier Mullard OA70 (J2B only)	342
M1	Meter 0-40V AC 0-0.89mA DC (J2B only)	A15132
N1	Neon pilot lamp 100-125V	1165
S1	Range switch D No. A4876	17267
S2	Attenuator switch	7702
S3	Mains switch	
T1	Output transformer low	MT315
T2	Output transformer high	MT316
T3	Mains transformer	MT314B
	Input 105-125V / 210-250V — 50-100c/s	
TH1	ST&C Thermistor 1522/100	6719
TH2	Thermistor A14	7811
	Instruction Manual	17869



NOTES

1. For J1B NA only, T3 primary winding is for 117V 25-60c/s supplies.
2. Meter M1 used on Sig. Gen. J2B only.
3. All D.C. measurements with 20KΩ per Volt Meter. All A.C. measurements with A.C. Millivolt Meters (Advance Type 77C) with J1B, J2B set to 1Kc/s sinewave 25V output.



V1
ECC88

V2
6C4 (EC90)

V3
EL84

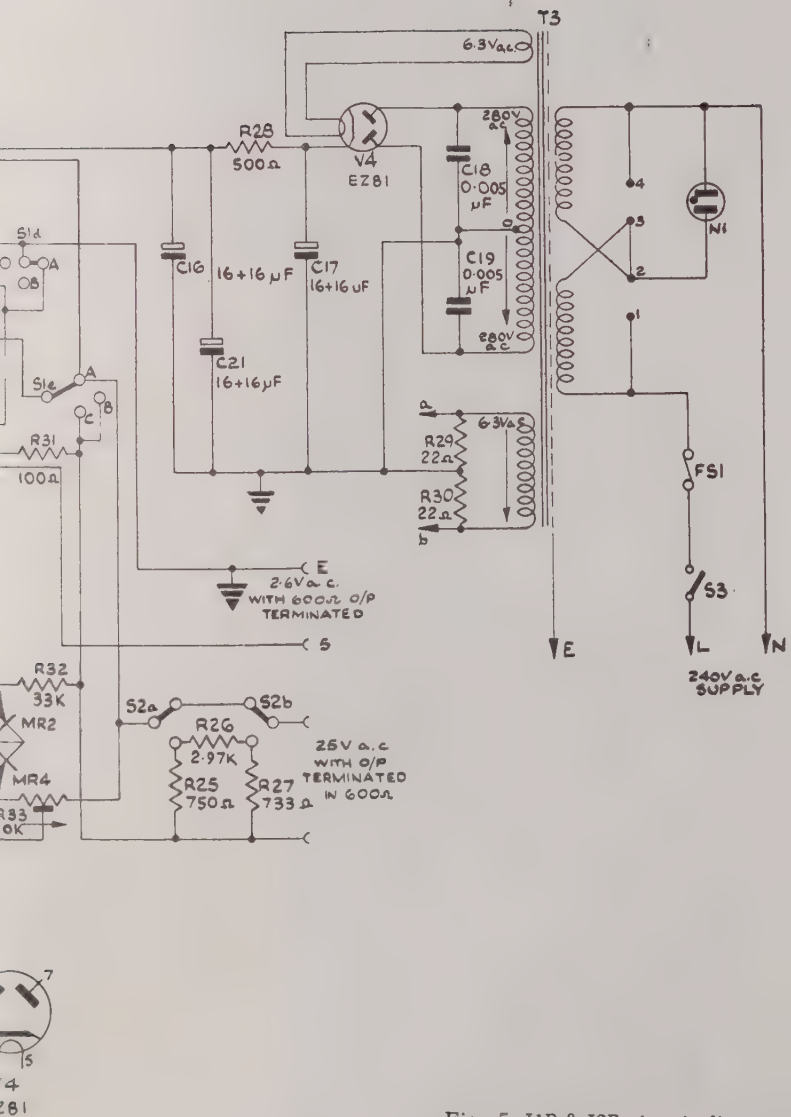


Fig. 5 J1B & J2B circuit diagram

Guarantee and Service Facilities *Section 7*

This instrument is guaranteed for a period of one year from its delivery to the purchaser, covering the replacement of defective parts other than valves, semiconductors and fuses. Valves and semiconductors are subject to the manufacturers' guarantee.

We maintain comprehensive after sales facilities and the instrument can, if necessary, be returned to our factory for servicing. The Type and Serial Number of the instrument should always be quoted, together with full details of the service required. The Service Department can also provide maintenance and repair information by telephone or letter.

Equipment returned to us for servicing must be adequately packed, preferably in the special box supplied, and shipped with transportation charges prepaid. We can accept no responsibility for instruments arriving damaged. Should the cause of failure during the guarantee period be due to misuse or abuse of the instrument, or if the guarantee has expired, the repair will be put in hand without delay and charged unless other instructions are received.

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